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Electric space heater using incandescent lamps - heat exchanger sheet material is folded in accordion fashion to provide multiple layers of sheet material
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Patent Family:

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EP 328893	A	19890823	EP 89100880	A	19890119	198934	B
US 4900898	A	19900213	US 88146241	A	19880120	199013	
CA 1301816	C	19920526	CA 588198	A	19890113	199227	
EP 328893	B1	19931229	EP 89100880	A	19890119	199401	
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			EP 89100880	A	19890119		

Priority Applications (No Type Date): US 88146241 A 19880120
Patent Details:

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US 4900898	A		10		
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Abstract (Basic): EP 328893 A
The electric space heater includes an exterior case (10) which encloses an insulated heater core housing (12). Heat is generated in the heater core (14) by elongated incandescent ultraviolet lamps (64) mounted in a frame (60) inside the core housing (12). A porous aluminium sheet heat exchanger (68) surrounds the lamps (64) on three sides and extends the length of the lamps.

A fan (34) mounted in an inlet opening (27) of a rear wall (22) of the case (10) forces air through an opening (52) in the core housing (12) through the heat exchanger (68) and around the lamps, and through outlet openings (28,54) to the space to be heated. The core housing (12) is U-shaped with curved portions (46,48) to laminate the air flow.

ADVANTAGE - Max. efficiency.
Abstract (Equivalent): EP 328893 B

An electric space heater comprising: a substantially closed housing (12) having an inlet opening (52) at one side and an outlet opening (54) at another side thereof; a heat source (64) comprising at least one lamp within the housing; a heat exchanger (68) adjacent to the heat source (64) for receiving heat from the heat source (64) and having openings; and an air driver to drive air from the inlet opening (52) across the heat exchanger (68) to absorb heat therefrom and out through the outlet opening (54) of the housing (12), characterised by: said at least one lamp being an elongated lamp (64); the heat exchanger (68) comprising a foraminous sheet material at least partially surrounding the at least one elongated lamp in closely spaced relationship thereto, said foraminous sheet material (68) having at least one face which is positioned between the inlet opening (52) and the at least one elongated lamp (64), said face lying substantially transverse to the direction of the flow of air immediately leaving said inlet opening (52) so that the air from the inlet opening (52) is driven against and through said foraminous sheet material (68); and means (46,48) for directing the air toward the outlet opening (54) in a smooth laminar flow.

Dwg.1/5

Abstract (Equivalent): US 4900898 A

A heat exchanger is adjacent to the heat source for receiving heat from the heat source. Air is driven from the inlet opening by way of the heat exchanger to absorb heat and out through the outlet opening of the housing. The housing is closed and the heat source comprises at least one elongated lamp, the elongated lamp having a longitudinal axis which is transverse to the direction of the flow of air from the inlet opening. The heat exchanger comprises a foraminous sheet material at least partially surrounding the at least one elongated lamp in closely spaced relationship.

The foraminous sheet has at least one face which is transverse to the direction of the flow of air from the inlet opening and between the inlet opening and the elongated lamp. The air from the inlet opening is driven against and through the foraminous sheet material and around the at least one elongated lamp to absorb heat from the elongated lamp and from the foraminous sheet material in turbulent flow.

USE - Electric space heater operated by elongate incandescent lamps.

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(54) Electric space heater.

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(56) References cited:
FR-A- 2 442 409
GB-A- 332 709
US-A- 4 307 284
US-A- 4 309 594
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EP 0 328 893 B1

Description

This invention relates to an electric space heater according to the preamble of claim 1.

The concept of an electric space heater utilizing incandescent or other electric lamps as a heat source, with a fan and a heat exchanger mounted within a housing is well known. An example of such a space heater is disclosed in US-A-4,307,284. This document discloses an electrical space heater unit in which conventional incandescent bulbs are mounted in a housing and a metal strip with metal fins is provided directly above and in contact with the incandescent bulbs to serve as a heat exchanger. The upper portion of the housing is open for passage of heated air from the housing into the space to be heated.

An electric space heater as mentioned above is disclosed in US-A-4,309,594. This document discloses a modular space heater device in which conventional infrared heat lamps are mounted in a housing and a heat exchanger plate is mounted above the bulbs. The heat exchanger plate has a number of openings with open ended pipes mounted in the openings for air to pass through. A fan blows air from an inlet in the housing across the infrared bulbs, around the heat exchanger plate, through the tubes in the heat exchanger plate and through an open outlet in the housing.

US-A-4,680,448 discloses a space heater very similar to the heater disclosed in US-A-4309594, but with a different type of heat exchanger. Fester discloses a heat exchanger comprising a plurality of parallel copper tubes, surrounded by a plurality of parallel aluminum fins connected to and perpendicular to the tubes. A portion of the fins are coated with a black carbon paint.

The above-described space heaters fail to maximize efficiency because the heat exchangers do not surround the heat source, and thus do not absorb and transfer as much heat as possible. Considerable heat from the lamp is lost because it is directed away from the heat exchanger. Also, existing units seem to cause undue turbulence of the air flow, thus reducing efficiency. The sharp corners or convoluted air flow channels of existing heaters generate turbulence. The spherical or conical shape of the lamps which serve as a heat source also contribute to turbulence. Furthermore the spherical or conical shape of the lamps in existing heaters creates an uneven distribution of heat in the heat exchangers. Existing portable space heaters can generally produce approximately 5485 kJ (5200 BTU) of heat at 1500 watts of power.

It is desirable to be able to enhance the efficiency of such electric space heaters by maximizing the heat transfer from the heat source to the air moving through the space heater. Efficiency can be enhanced by providing means to more evenly distribute heat over a heat exchanger, enabling the heat exchanger to absorb more heat, and laminating the air flow through the heater. This is achieved by an electric space heater according to the invention as defined in claim 1.

The elongated lamps are high-intensity light bulbs, preferably those which have a length-to-diameter ratio in the range of 5:1 to 15:1, preferably about 10:1. The preferred elongated lamps are quartz UV lamps.

The heat exchanger is made of a sheet material having high thermal conductivity. Preferably, the thickness of the sheet material is in the range of 0,25 mm to 0,76 mm (0.010 to 0.030 inches) and has a pattern of openings therein. The openings in the heat exchanger sheet material comprise from 40 to 65 percent of the surface area of the sheet, preferably about 55 percent. Further, the openings have an average diameter in the range of 6,35 mm to 12,7 mm (0.25 inches to 0.5 inches), preferably about 9,5 mm (0.375 inches). Preferably, the sheet material is formed from an aluminum sheet having a thickness of about 0,5 mm (0.020 inches) thick and has openings in the sheet material which comprise about 55 percent of the surface area of the sheet.

The heat exchanger sheet is configured so that it extends at least 270° around the at least one elongated lamp. The heat exchanger preferably is folded in accordion fashion to provide multiple layers of the sheet. Further, the heat exchanger is preferably rectangular in cross-section and there are at least two elongated lamps positioned within the heat exchanger.

The inlet opening of the housing is preferably positioned in a central portion of the one side of the housing adjacent a side of the heat exchanger to direct air directly against the heat exchanger side. Further, the outlet opening is preferably positioned on an opposite side of the housing from the heat exchanger so that the air must flow through and around the heat exchanger between the inlet and the outlet openings in the housing. Preferably, there are two outlet openings in the housing, each positioned at an opposite end of the opposite side of the housing. The means to drive the air from the inlet across the heat exchanger preferably comprises a fan in the inlet opening. The housing is preferably insulated and has means for directing the air in a smooth laminar flow through the housing.

The interior surfaces of the heater and the heat exchanger are coated with a heat absorbing coating to enhance the heat transfer between these surfaces and the air.

The invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a plan view in section of an electric space heater according to the invention;

Figure 2 is a cross-sectional view of the space heater of Figure 1 taken along lines 2-2 thereof;

Figure 3 is a front elevational view, in section, of the space heater of Figure 1, taken along lines 3-3 thereof;

Figure 4 is a perspective exploded view of the space heater of Figures 1 through 3; and

Figure 5 is an electrical schematic diagram of a circuit suitable for use in the space heater shown in Figures 1 through 3.

Referring now to Figures 1, 2, 3, and 4, there is shown a preferred embodiment of an electric space heater constructed in accordance with the invention. The heater comprises generally an exterior case 10, a core housing 12 mounted inside the exterior case 10, and a heater core 14 mounted inside the core housing 12.

The exterior case 10 is generally a box-like structure comprising a front wall 20, a rear wall 22, a bottom 23, two opposing side walls 24 and a top wall 26. The case 10 can be constructed of metal, or any other suitable material able to withstand heat, in order to provide an aesthetically pleasing appearance to the case 10. An inlet opening 27 is defined centrally in the rear wall 22. Two outlet openings 28 are provided in the front wall 20, one at each end thereof. An intake grill 29 covers the inlet opening 27 for protection, and likewise, each outlet opening 28 is protected by an outlet grill 30. An axial fan 34 is mounted in the inlet opening 27 to force air to the interior of the case 10. A switch 32 can be mounted on the case 10, preferably on the rear wall 22. The top wall 26 is removable to provide access to the interior of the case 10. Alternatively, the top 26 can be hinged to one of the walls 20, 22, 24.

The exterior case 10 encloses a core housing 12. The core housing 12 comprises a rear wall 40 and a front wall 42 rigidly secured to a bottom 44. The rear wall 40 has a rear curved portion 46 at each end thereof, and the front wall 42 likewise has a front curved portion 48 at each end thereof. The curved portions 46, 48 are aligned such that the core housing 12 forms a U-shaped channel. The curved portions 46, 48 are provided in order to establish a more laminar flow of air through the core housing 12. A top 50, roughly conforming to the same shape as the bottom 44, is removably mounted to the walls 40, 42 to permit access to the interior. A core inlet opening 52 is disposed in the rear wall 40 of the core housing 12, such that when the core housing 12 is mounted in the exterior case 10, the core inlet opening 52 is aligned with and adjacent to the fan 34 mounted in the exterior case 10. Each end of the core housing 12 has a core outlet opening 54. The core housing 12 is dimensioned such that each core outlet opening 54 is aligned with and has roughly the same geometric shape as the corresponding outlet openings 28 of the case 10 when the core housing 12 is mounted in the exterior case 10. Also, the core outlet openings 54 are immediately adjacent to the case outlet openings 28 so as to provide two contiguous outlets from the interior of the core housing 12 to the space to be heated. Insulation 56 completely surrounds the core housing 12 inside the exterior case 10 with the exception of the core inlet opening 52 and core outlet openings 54. The insulation 56 should preferably be of a type graded to a maximum temperature of 648 °C (1200 °F). A suitable insulation is 25,4 mm (1 inch) thick K-FAC 19® high temperature board manufactured by U.S. Gypsum Co. The core housing is preferably made of aluminum of a thickness up to 1,5 mm (0.060 inches), more or less. Materials other than aluminum can also be used, if they sufficiently retain heat inside the core housing 12. The entire interior of the core housing 12 is coated with a high heat absorbant paint, for example Thurmalox®, manufactured by Dampney Co., Everett, Massachusetts. The paint should preferably be black in color in order to absorb and retain as much heat as possible.

The core housing 12 completely encloses a heater core 14. The heater core comprises a U-shaped frame 60, which can be made of the same material as the core housing 12. The frame 60 comprises a base 61 and two oppositely disposed arms 62 extending perpendicularly from the ends of the base 61. The frame 60 is thus adapted to hold a plurality of elongated incandescent lamps 64 which serve as a heat source. In a preferred embodiment, each lamp is a red quartz ultraviolet lamp, of conventional design. For example, lamp no. QHT3 manufactured by General Electric Corporation, which draws approximately 375 watts of power can be used. Each lamp 64 is preferably mounted by inserting each end thereof in a spring-loaded porcelain bulb holder 63, which in turn is secured to each opposing arm 62 of the frame 60. Thus, each lamp 64 extends between the opposing arms 62 of the frame 60. While the actual number of lamps may vary, the embodiment shown herein includes two lamps positioned in vertical juxtaposition in the frame 60. Wiring 66 extends to and from the lamps and should be suitably insulated to a temperature of 648 °C (1200 ° F).

A heat exchanger 68 longitudinally surrounds the lamps 64 and extends slightly beyond the arms 62 of the frame 60 on three sides. The heat exchanger 68 is preferably made of a high heat conductivity sheet material, such as aluminum, and

further comprises a multiplicity of small openings or open mesh pattern to allow the free flow of air through the exchanger 68. The openings can be of any pattern: round, square or cross shaped. Aluminum screen could also be used for the heat exchanger. The sheet material forming the exchanger is preferably relatively thin, for example in the range of 0,25 to 0,76 mm (0.010 to 0.030 inches) thick. In the preferred embodiment described herein, the heat exchanger 68 is formed from 0,5 mm (0.020 inch) thick aluminum sheet with a pattern of cross openings. The average mean diameter of the openings is preferably about 9,5 mm (0.375 inches) and spaced apart such that the total area of the openings comprise about 55 percent of the surface area of the exchanger 68. The total area of the openings can range anywhere from approximately 40 percent to 65 percent of the total surface area of the sheet. Typically, each opening ranges from 6,35 to 12,7 mm (0.25 to 0.50 inches) mean diameter. The exchanger 68 can have a plurality of layers of the high heat conductivity material surrounding the lamps 64. The layers can be connected to each other in suitable fashion, or, as shown in the present embodiment, made of one piece of material folded back on itself in accordion-like fashion to form a plurality of layers on each of the three sides of the heat generating lamps 64. The function of the heat exchanger is to absorb heat from the lamps and transfer that heat to air which passes over the surfaces thereof. The heat exchanger must also permit the flow of air therethrough to cool the lamps and take heat from the space between the lamps 64 and the heat exchanger 68. The heat exchanger 68 can be dimensioned to slidably engage the arms 62 of the frame 60. It can thus be held in place by frictional engagement of the interior layer of the exchanger 68 with the sides of the arms 62. Alternatively, a suitable fastening means such as screws or pins can be provided to secure the heat exchanger 68 to the frame 60. The heat exchanger 68 is preferably coated with the same heat absorbent paint as the interior of the core housing 12, as is the frame 60.

Figure 5 illustrates a preferred electrical circuitry to operate the space heater according to the invention. The fan 34 and lamps 64 are connected in parallel to a conventional 120 volt a.c. source by means of a standard plug 78. The on-off switch 32 controls the activation and deactivation of the fan 34 and lamps 64. Because the fan 34 and lamps 64 are connected in parallel, when one is activated they all are activated. The core 14 is preferably grounded by conventional means. A high temperature limiting switch (not shown) can be disposed at any suitable location in the core housing 12 and electrically connected between the power source and the switch 32. Thus, when the temperature in the core exceeds a predetermined level, the switch will automatically cut off electrical power to the fan 34 and lamps 64, preserving the life of the components and providing a margin for safety in the use of the heater. Also, a thermostat (not shown) can be incorporated into the electrical circuitry to automatically control the activation and deactivation of the fan 34 and lamps 64 in response to changes in the ambient temperature.

In operation, the fan 34 in the exterior case 10 draws air into the unit through the inlet opening 27 of the exterior case 10 and forces it into the core housing 12 through the core inlet opening 52. The lamps 64 in heater core 14 generate heat which is taken up and absorbed by the heat exchanger 68, and, to a somewhat lesser extent, the interior of the walls of the core housing 12. The air passing from the core inlet opening 52 of the core housing 12 passes through the openings in the heat exchanger 68 and is deflected through the core housing 12, all the while absorbing heat from the heat exchanger 68 and the interior of the core housing 12. The air is directed through the U-shaped passageway formed by the core housing 12 to exit from the core outlet openings 54 of the core housing 12, which are directly aligned with and adjacent to the outlet openings 28 of the exterior case 10, into the space to be heated. The curved portions 46, 48 of the core housing 12 serve to smooth and laminate the air flow, thus reducing turbulence and increasing the efficiency of the unit. The use of an elongated lamp 64 adjacent to and surrounded on at least three sides by the heat exchanger 68 serves to enhance the efficiency of the heat transfer from the heat source to the heat exchanger and permit a more even distribution of heat throughout the heat exchanger.

Tests of a prototype space heater constructed in accordance with the invention have shown that 11600 kJ (11,000 BTU) of heat can be generated from approximately 600 watts of power. The particular unit tested drew 5.5 amps of current. The heater core of the tested unit comprised two 20 cm (8 inch) long quartz UV lamps, each approximately 19 mm (0.75 inches) in diameter and spaced apart about 12,7 mm (0.5 inches). A single layer of sheet aluminum, 0,5 mm (0.020 inches) thick, surrounded the lamps on three sides with less than 50 mm (2 inches) of space therebetween. Cross-shaped perforations in the sheet had a mean diameter of 9,5 mm (0.375 inches) and the total area of the openings comprised about 55 percent of the total surface area of approximately 451 cm^2 (70 square inches). The total area of the outlet openings measured approximately 97 cm^2 (15 square inches). Air at an ambient temperature of 21 °C (70 ° F) was forced through the unit at 1982 L/min (70 CFM).

After seven minutes of operation, the air temperature at the outlets measured 149 • C (300 • F).

As can be seen in Fig. 4, replacement of the internal components of the heater can be easily accomplished by removing the top wall 26 from the exterior case 10 to expose the core housing and a portion of the electrical circuitry. Likewise, the top 50 of the core housing 12 can be removed to expose the core 14. Further, the heat exchanger 68 can be pulled vertically off of the frame 60 to expose the lamps 64. In addition, the materials for construction are relatively inexpensive, thus reducing the costs of manufacture.

A space heater in accordance with the invention can be adapted for use in remote vehicles such as automobiles, trucks, recreation vehicles and the like by modifying the electrical circuitry and the heat generating lamps to operate from direct current. The small, relatively compact size of an electric space heater afforded by the present invention also makes it adaptable for use in clothes dryers and other appliances. It is also possible to completely enclose the lamps by the heat exchanger to 360 • by adapting the means to hold the lamps. The close spacing between the high intensity lamps and the heat exchanger, the thin porous nature of the heat exchanger and the configuration of the heat exchanger and the lamps make the heater very efficient and very compact.

It will thus be seen that according to the present invention an electric space heater has been provided with enhanced efficiency, simplified design, and less cost. Reasonable variation and modifications are possible within the scope of the foregoing disclosure and drawings without departing from the spirit of the invention which is defined by the appended claims.

Claims

1. An electric space heater comprising:
   a substantially closed housing (12) having an inlet opening (52) at one side and an outlet opening (54) at another side thereof;
   a heat source (64) comprising at least one lamp within the housing;
   a heat exchanger (68) adjacent to the heat source (64) for receiving heat from the heat source (64) and having openings; and
   an air driver to drive air from the inlet opening (52) across the heat exchanger (68) to absorb heat therefrom and out through the outlet opening (54) of the housing (12), **characterized** by:
   said at least one lamp being an elongated lamp (64);
   the heat exchanger (68) comprising a foraminous sheet material at least partially surrounding the at least one elongated lamp in closely spaced relationship thereto, said foraminous sheet material (68) having at least one face which is positioned between the inlet opening (52) and the at least one elongated lamp (64), said face lying substantially transverse to the direction of the flow of air immediately leaving said inlet opening (52), so that the air from the inlet opening (52) is driven against and through said foraminous sheet material (68); and
   means (46, 48) for directing the air toward the outlet opening (54) in a smooth laminar flow.

2. An electric space heater according to claim 1 wherein the elongated lamp (64) has a length to diameter ratio in the range of 5:1 to 15:1.

3. An electric space heater according to claims 1 or 2 wherein the heat exchanger sheet material (68) has a thickness in the range of 0,25 to 0,76 mm (0.010 to 0.030 inches).

4. An electric space heater according to claims 1 or 3 wherein the perforations in the heat exchanger sheet material (68) have an average mean diameter in the range of 6,35 to 12,7 mm (0.25 to 0.5 inches) and comprise from 40 to 65 percent of the surface area of the sheet material, whereby air can flow through said heat exchanger (68) and around said at least one elongated lamp (64).

5. An electric space heater according to claim 4 wherein the heat exchanger sheet material (68) is formed of an aluminum sheet with a thickness of about 0,5 mm (0.020 inches), the perforations in the sheet material comprise about 55 percent of the surface area of the sheet, and the average mean diameter of the openings is about 9,5 mm (0.375 inches).

6. An electric space heater according to claims 1, 2 or 5 wherein the heat exchanger sheet material (68) extends at least 270 degrees around the elongated lamp (64).

7. An electric space heater according to claims 1, 3 or 6 wherein the heat exchanger sheet material (68) is folded in an accordion fashion to provide multiple layers of sheet material.

8. An electric space heater according to claims 1, 2, 3 or 6 wherein the inlet opening (52) is positioned in a central portion of one side of the housing (12) adjacent a side of the heat exchanger (68) to direct air directly against said heat exchanger side.

9. An electric space heater according to claim 8 wherein the outlet opening (54) is positioned on a side of the housing (12) opposite that of the inlet opening (52).

10. An electric space heater according to claim 9 wherein there are two outlet openings (54) in the housing (12), each positioned on a side of the housing (12) opposite that of the inlet opening (52).

Patentansprüche

1. Elektrischer Raumheizer mit einem im wesentlichen geschlossenen Gehäuse (12), das eine Einlaßöffnung (52) an einer Seite und eine Auslaßöffnung (54) an einer anderen seiner Seiten hat, mit einer Wärmequelle (64), die wenigstens eine Lampe innerhalb des Gehäuses umfaßt, mit einem an die Wärmequelle (64) angrenzenden Wärmeaustauscher (68), der Wärme aus der Wärmequelle (64) aufnimmt und mit Öffnungen versehen ist, und mit einem Lufttreiber, der Luft aus der Einlaßöffnung (52) zur Aufnahme von Wärme aus dem Wärmeaustauscher (68) über denselben und durch die Auslaßöffnung (54) aus dem Gehäuse (12) treibt, dadurch gekennzeichnet, daß diese wenigstens eine Lampe (64) eine längliche Lampe (64) ist, daß der Wärmeaustauscher (68) ein Lochblechmaterial umfaßt, welches diese wenigstens eine längliche Lampe in einem dazu eng beabstandetem Verhältnis zumindest teilweise umgibt, daß das Lochblechmaterial (68) wenigstens eine Fläche hat, die sich zwischen der Einlaßöffnung (52) und der wenigstens einen länglichen Lampe (64) befindet, wobei diese Fläche im wesentlichen quer zur Strömungsrichtung der die Einlaßöffnung (52) unmittelbar verlassenden Luft liegt, so daß die Luft aus der Einlaßöffnung (52) gegen und durch das Lochblechmaterial (68) getrieben wird, und daß Mittel (46,48) vorgesehen sind, die die Luft in einer gleichmäßigen Laminarströmung in Richtung auf die Auslaßöffnung (54) lenken.

2. Elektrischer Raumheizer nach Anspruch 1, dadurch gekennzeichnet, daß die längliche Lampe (64) ein Verhältnis zwischen Länge und Durchmesser hat, das in dem Bereich von 5:1 bis 15:1 liegt.

3. Elektrischer Raumheizer nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß das Wärmeaustauscherblech (68) eine Dicke im Bereich von 0,25 bis 0,76 mm (0.010 bis 0.030 inches) aufweist.

4. Elektrischer Raumheizer nach Anspruch 1 oder 3, dadurch gekennzeichnet, daß die Perforationen in dem Wärmeaustauscher-Blechmaterial (68) einen durchschnittlichen mittleren Durchmesser in dem Bereich von 6,35 bis 12,7 mm (0.25 bis 0.5 inches) haben und 40 bis 65 Prozent der Mantelfläche des Blechmaterials belegen, wodurch Luft durch den Wärmeaustauscher (68) und um diese wenigstens eine längliche Lampe (64) herum strömen kann.

5. Elektrischer Raumheizer nach Anspruch 4, dadurch gekennzeichnet, daß das Wärmeaustauscher-Blechmaterial (68) aus Aluminiumblech mit einer Dicke von etwa 0,55 mm (0.020 inches) besteht, wobei die Perforationen in dem Blech etwa 55 Prozent der Mantelfläche des Bleches belegen und der durchschnittliche mittlere Durchmesser der Öffnungen etwa 9,5 mm (0.375 inches) beträgt.

6. Elektrischer Raumheizer nach Anspruch 1, 2 oder 5, dadurch gekennzeichnet, daß sich das Wärmeaustauscher-Blechmaterial (68) über zumindest 270 Grad um die längliche Lampe (64) herum erstreckt.

7. Elektrischer Raumheizer nach Anspruch 1, 3 oder 6, dadurch gekennzeichnet, daß das Wärmeaustauscher-Blechmaterial (68) akkordeonartig gefaltet ist, so daß mehrere Blechmaterialschichten gebildet werden.

8. Elektrischer Raumheizer nach Anspruch 1, 2, 3 oder 6, dadurch gekennzeichnet, daß die Einlaßöffnung (52) in einem zentralen Bereich einer Seite des Gehäuses (12) angrenzend an eine Seite des Wärmeaustauschers (68) positioniert ist, um die Luft direkt gegen die Wärmeaustauscherseite zu richten.

9. Elektrischer Raumheizer nach Anspruch 8, dadurch gekennzeichnet, daß die Auslaßöffnung (54) an einer Seite des Gehäuses (12) positioniert ist, die jener der Einlaßöffnung (52) gegenüberliegt.

10. Elektrischer Raumheizer nach Anspruch 9, daß in dem Gehäuse (12) zwei Auslaßöffnungen (54) vorhanden sind, deren jede an einer Seite des Gehäuses (12) positioniert ist, die jener der Einlaßöffnung (52) gegenüberliegt.

Revendications

1. Appareil de chauffage électrique d'un espace, comportant :
   une enceinte (12) sensiblement fermée

ayant une ouverture d'entrée (52) sur un côté et une ouverture de sortie (54) sur un autre côté ;

une source (64) de chaleur comprenant au moins une lampe à l'intérieur de l'enceinte ;

un échangeur (68) de chaleur adjacent à la source (64) de chaleur pour recevoir de la chaleur de la source (64) de chaleur et présentant des ouvertures ; et

un dispositif d'entraînement d'air destiné à entraîner de l'air depuis l'ouverture d'entrée (52) à travers l'échangeur de chaleur (68) pour en absorber de la chaleur et le faire sortir à travers l'ouverture de sortie (54) de l'enceinte (12), caractérisé en ce que :

ladite lampe ou chaque lampe est une lampe allongée (64) ;

l'échangeur (68) de chaleur comprend une feuille de matière perforée entourant au moins partiellement la ou chaque lampe allongée dans une disposition rapprochée avec elle, ladite feuille de matière perforée (68) ayant au moins une face qui est positionnée entre l'ouverture d'entrée (52) et la ou chaque lampe allongée (64), ladite face s'étendant sensiblement transversalement à la direction de l'écoulement d'air quittant immédiatement ladite ouverture d'entrée (52), de manière que l'air provenant de l'ouverture d'entrée (52) soit entraîné contre et à travers ladite feuille de matière perforée (68) ; des moyens (46, 48) pour diriger l'air vers l'ouverture de sortie (54) en un écoulement laminaire doux.

2. Appareil de chauffage électrique d'espace selon la revendication 1, dans lequel la lampe allongée (64) a un rapport de la longueur au diamètre dans la plage de 5:1 à 15:1.

3. Appareil de chauffage électrique d'espace selon la revendication 1 ou 2, dans lequel la feuille de matière (68) de l'échangeur de chaleur a une épaisseur dans la plage de 0,25 à 0,76 mm (0,010 à 0,030 inch).

4. Appareil de chauffage électrique d'espace selon la revendication 1 ou 3, dans lequel les perforations de la feuille de matière (68) de l'échangeur de chaleur ont un diamètre moyen dans la plage de 6,35 à 12,7 mm (0,25 à 0,5 inch) et constituent 40 à 65 % de l'aire de la surface de la feuille de matière, de manière que de l'air puisse s'écouler à travers ledit échangeur (68) de chaleur et autour de ladite ou de chaque lampe allongée (64).

5. Appareil de chauffage électrique d'espace selon la revendication 4, dans lequel la feuille de matière (68) de l'échangeur de chaleur est formée d'une feuille d'aluminium d'une épaisseur d'environ 0,5 mm (0,020 inch), les perforations dans la feuille de matière constituent environ 55 % de l'aire de la surface de la feuille et le diamètre moyen des ouvertures est d'environ 9,5 mm (0,375 inch).

6. Appareil de chauffage électrique d'espace selon la revendication 1, 2 ou 5, dans lequel la feuille de matière (68) de l'échangeur de chaleur s'étend sur au moins 270° autour de la lampe allongée (64).

7. Appareil de chauffage électrique d'espace selon la revendication 1, 3 ou 6, dans lequel la feuille de matière (68) de l'échangeur de chaleur est pliée en accordéon pour former des couches multiples de cette feuille de matière.

8. Appareil de chauffage électrique d'espace selon la revendication 1, 2, 3 ou 6, dans lequel l'ouverture d'entrée (52) est positionnée dans une partie centrale d'un côté de l'enceinte (12) à proximité immédiate d'un côté de l'échangeur (68) de chaleur pour diriger de l'air directement contre ledit côté de l'échangeur de chaleur.

9. Appareil de chauffage électrique d'espace selon la revendication 8, dans lequel l'ouverture (54) de sortie est positionnée sur un côté de l'enceinte (12) opposé à celui de l'ouverture d'entrée (52).

10. Appareil de chauffage électrique d'espace selon la revendication 9, dans lequel il y a deux ouvertures (54) de sortie de l'enceinte (12), positionnées chacune sur un côté de l'enceinte (12) opposé à celui de l'ouverture d'entrée (52).

FIG. 1

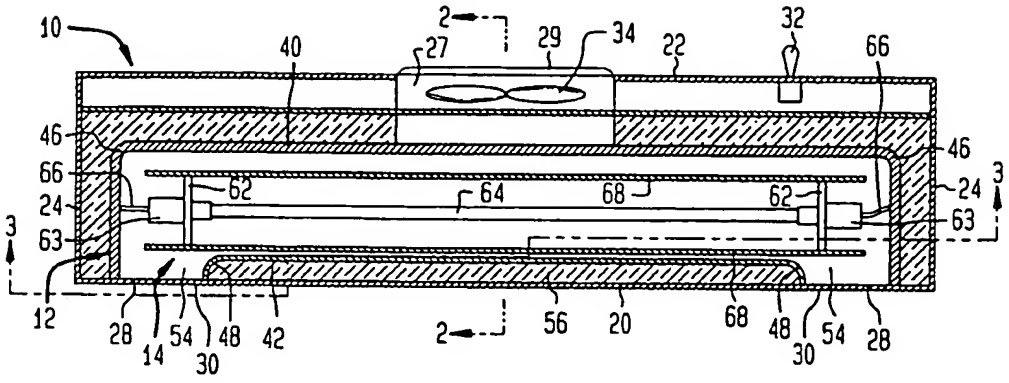
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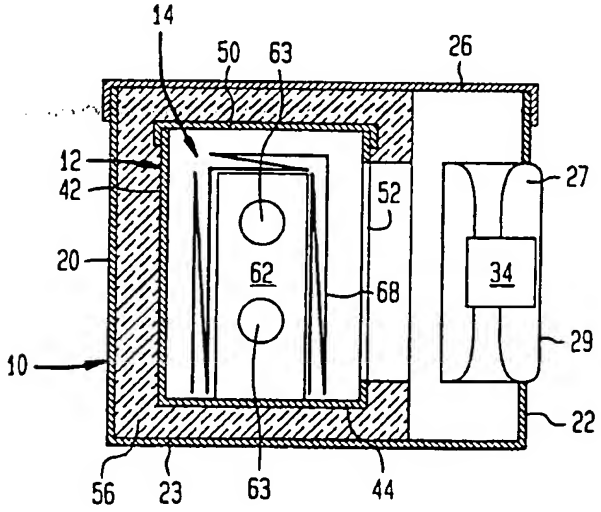
FIG. 2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44

FIG. 3

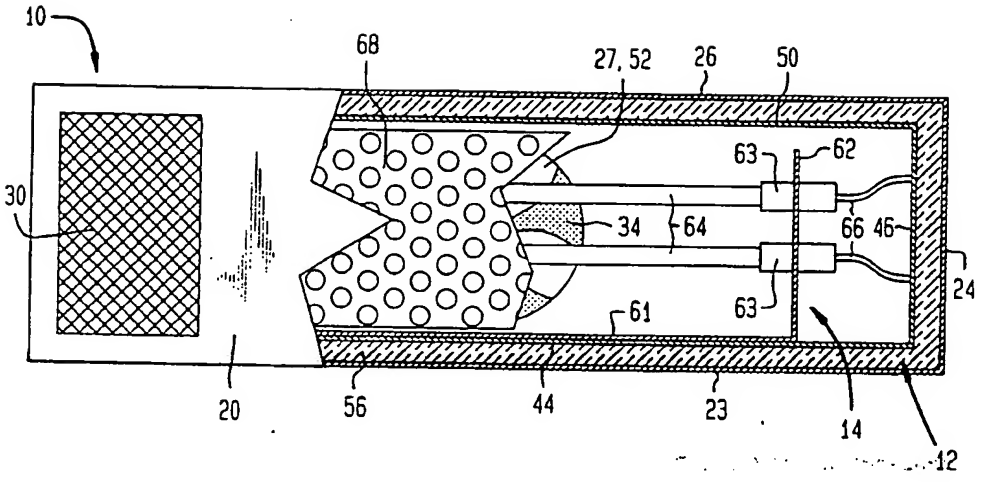

FIG. 4

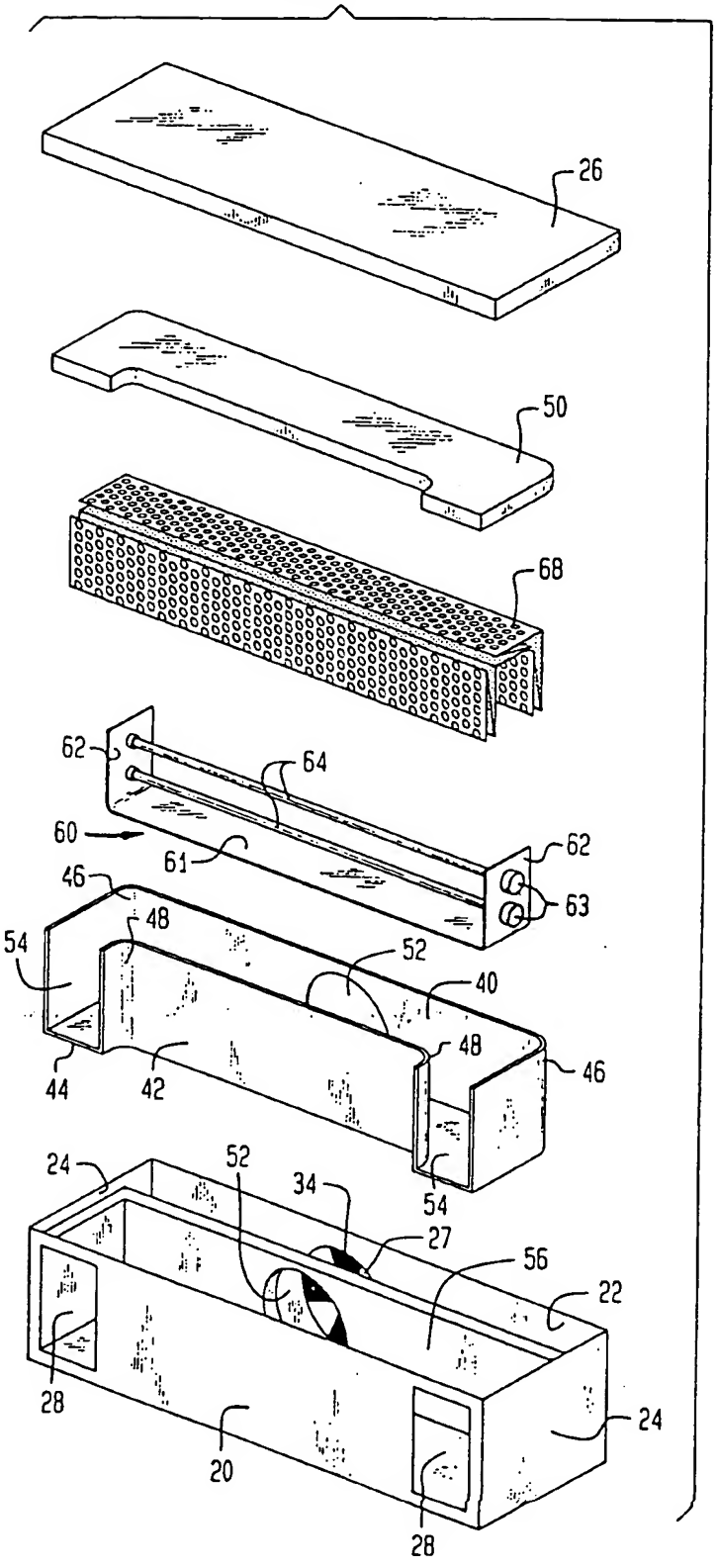
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FIG. 5